

SOIL SURVEY OF DAKOTA COUNTY, NEBRASKA.

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DESCRIPTION OF THE AREA.

Dakota County is located in the northeastern corner of Nebraska, being separated from Iowa by the Missouri River. The county is almost square, being 18 miles long on the southern edge and 17 miles on the western edge, but the Missouri River makes the eastern and northern boundaries somewhat irregular. Dakota County comprises an area of 258 square miles, or 165,120 acres. Sioux City, Iowa, is located just across the river from the northeastern corner of the county.

The county consists broadly of two main topographic divisions, the upland, consisting of a more or less eroded plain, comprising about three-fifths of the area, and the stream valleys, which may be subdivided into alluvial or colluvial slopes and first bottoms, occupying the remainder.

The upland covers the western part of the county, its eastern boundary crossing the northern line $4\frac{1}{4}$ miles east of the northwest corner and extending diagonally across the county to the southeast corner. In general the upland has a rolling to hilly topography. It is nearly everywhere eroded by streams and in a number of places almost entirely reduced to ridges and valleys. There are some gently undulating areas, though very few are comparatively flat. The original plain surface exists only in the small flat areas on the highest parts of the divides. Except in the bluff zone the drainage ways of the upland are not sharply cut and the hills are well rounded—a conspicuous feature of the topography.

The relief in the east-central and south-central parts of the county is less than in any other of the upland portion, being here rolling to gently undulating and the slopes to stream channels comparatively long and gradual. In the remainder of the upland, especially in the northern part and along the bluff line bordering the alluvial division of the county, the surface is completely dissected and the slopes are

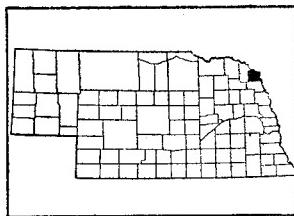


FIG. 38.—Sketch map showing location of the Dakota County area, Nebraska.

very steep to precipitous. The roughest topography is in a belt 3 or 4 miles wide along the bluffs bordering the Missouri River bottoms. The slopes here are blufflike, and cliffs 10 to 50 feet high are common, the divides are narrow, and very little, if any, of the constructional surface remains. The eastern boundary of the upland abuts directly on the first bottoms of the Missouri River, except in the extreme northern part of the county, where for 2 miles the river hugs the bluff.

The alluvial and colluvial slope land occurs chiefly along the larger streams in the upland. The large areas of first-bottom soils lie between the bluffs and the Missouri River, while narrow strips of bottom land also occur along the larger streams in the upland part of the area. The colluvial slopes have a gently sloping topography, representing materials washed down from the adjoining uplands and deposited in the narrow valleys, and in many places the surface is so nearly level that it much resembles bench or terrace land.

The first bottoms, lying from 150 to 250 feet below the general level of the upland and 15 to 30 feet above the channel of the Missouri River, vary considerably in topography. Over most of the area of their occurrence the surface is almost flat, though broken slightly in places by minor depressions, oxbow lakes, cut-offs, old channels, overflow channels, and sand ridges. Northeast of Hubbard, on the north side of Pigeon Creek, is quite an extensive area having a somewhat basinlike topography, while on the north side of Crystal Lake the surface is in places modified by low sand ridges and hummocks. Immediately bordering the Missouri River are extensive areas of sand, silt, and clay bars, which lie but a few feet above the normal water level. The topography here is flat to very gently undulating and is more or less altered with each rise of the stream.

According to the United States Geological Survey, the elevation in the extreme northern part ranges from 1,100 feet above sea level on the Missouri River to 1,400 feet near the northwest corner. The river has a fall of about 1.5 feet per mile. The elevation of South Sioux City is 1,106, Dakota City 1,102, Emerson 1,426, Nacora 1,417, Hubbard 1,157, and Jackson 1,124 feet above sea level. The general slope of the upland is to the north and east and of the bottom land south and east.

Dakota County is drained entirely by the Missouri River and its tributaries, Elk and Omaha Creeks, both of which enter the river within the county. These creeks in turn are fed by an intricate system of smaller streams. In general, the drainage is to the north and east.

Omaha Creek, the largest creek in the county, drains the southern and central parts. The stream is deeply intrenched in its flood plain,

the channel being from 10 to 20 feet wide and 2 to 5 feet deep. Omaha Creek is fed by Fiddlers and Pigeon Creeks, the latter draining an extensive area in the central part of the county.

Elk Creek, together with its tributaries, drains the entire western and northwestern parts of the area. The stream channel is considerably smaller than that of Omaha Creek and is not so deeply intrenched in its flood plain.

A comprehensive drainage system, consisting of many small streams, spring branches, and intermittent drainageways, divide and subdivide the upland part of the county, and the drainage is everywhere adequate and in many places excessive. In the Missouri River bottoms the natural drainage is in places inadequate, but artificial drainage has been established, so that at the present time only a small percentage of the land is too wet for cultivation. The streams of the upland have a comparatively steep gradient and swift flow, but upon entering the Missouri River bottoms they become sluggish and are in many places filling their channels. There are several natural cut-off lakes in the county, Crystal, Jackson, and Blyburg Lakes being the largest.

The first settlement in Dakota County was made in 1855 near the present site of Homer. During the same year the county was organized by an act of the Territorial legislature; in 1858 part of it was annexed to Dixon County; in 1879 its southern boundary was moved south to the middle line of township 25 north, and in 1889 Thurston County was organized with the northern boundary of the Winnebago Reservation for its north line, leaving Dakota County with its present boundaries.

The early settlers were from Iowa, Missouri, Illinois, Indiana, Ohio, and other more eastern States. According to the 1920 census the population of the county is 7,694. It is all classed as rural, as there are no cities having 2,500 inhabitants. The density is 30.4 persons per square mile. With the exception of a greater density of settlement in the vicinity of the larger towns, the population is evenly distributed. The 1910 census shows 86.6 per cent of the inhabitants of the county native whites, and considerably more than half of these as of native parentage. Of the foreign nationalities represented German and Danish are the most important.

Dakota City, the county seat, lies in the eastern part of the county. According to the 1920 census, it has a population of 399. South Sioux City, 3 miles north of Dakota City, is the largest town in the county. It has 2,402 inhabitants. All travel across the river into Sioux City, Iowa, passes through this town. An electric railway extends from Sioux City to South Sioux City and much of the surplus dairy, poultry, and vegetable products are carried on this line. Homer, in the southeastern part of the county, has a population of 491.

Emerson is an incorporated town of 864 people, partly in each of the three counties, Dakota, Thurston, and Dixon. Hubbard in the central part of the county has a population of 152, Jackson in the north-central part has 274 inhabitants, while Willis, Goodwin, and Nacora are small villages in the western part.

The transportation facilities of Dakota County are good. A branch line of the Chicago, Burlington & Quincy Railroad extends across the eastern part from north to south. South Sioux City, Dakota City, and Homer are on this line. Another branch extends westward from Dakota City through Jackson and Goodwin. A branch of the Chicago, St. Paul, Minneapolis & Omaha Railroad extends through South Sioux City to Dakota City, thence west to Coburn where it forks, one branch extending southwestward through Hubbard, Nacora, and Emerson, and the other going in a northwesterly direction through Jackson and Willis. These lines give good traffic connections with Sioux City, Omaha, and Lincoln.

Most of the wagon roads follow section lines or land lines, but in the more hilly portions of the upland and along the bluffs between the upland and Missouri River bottoms many of them follow the valleys or lie on the slopes. The roads are well graded and kept in excellent condition where traffic is heavy; elsewhere they receive little attention. Most of the bridges are substantial, and concrete culverts are becoming common. There are no toll roads in the county, although toll is collected on the bridge across the Missouri River between Sioux City, Iowa, and South Sioux City.

Rural mail delivery service and telephone lines reach all parts of the county.

Sioux City is the principal market for the surplus grain and vegetable products. The live stock is shipped to the stockyards at Omaha.

CLIMATE.

The climate of Dakota County is typical of eastern Nebraska and is well suited to grain farming and stock raising. The long, warm summers are especially favorable to corn, while the low temperatures sometimes occurring in winter are not usually destructive to winter-grown crops, owing to the protection of snow. There is not sufficient variation in surface characteristics to cause any appreciable differences in climate within the county.

The data in the table below are compiled from the records of the Weather Bureau station at Sioux City, Iowa, and are believed to be accurately representative of local conditions.

Normal monthly, seasonal, and annual temperature and precipitation at Sioux City, Iowa.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1903).	Snow, average depth.
December.....	22.6	68	-22	0.74	0.32	0.21	5.4
January.....	15.6	63	-35	.55	.69	.06	6.2
February.....	19.8	75	-31	.55	.22	.66	7.9
Winter.....	19.3	75	-35	1.84	1.23	.93	19.5
March.....	32.6	88	-14	1.26	.03	1.85	5.4
April.....	48.5	98	13	2.77	.82	2.39	1.9
May.....	60.8	97	23	4.37	1.99	11.78	.1
Spring.....	47.3	98	-14	8.4	2.84	16.02	7.4
June.....	69.4	101	39	3.88	1.41	5.65	.0
July.....	74.2	107	41	3.61	3.69	5.57	.0
August.....	72.6	102	40	3.00	2.76	5.67	.0
Summer.....	72.0	107	39	10.49	7.86	16.89	.0
September.....	64.1	103	25	2.47	3.93	3.06	.0
October.....	51.1	92	10	1.79	.84	3.24	.3
November.....	34.3	77	-9	.97	.15	.96	2.9
Fall.....	49.8	103	-9	5.23	4.92	7.26	3.2
Year	47.1	107	-35	25.96	16.85	41.10	30.1

The mean annual temperature is 47.1° F. January is the coldest month, with a mean temperature of 15.6° F., and July is the warmest, with a mean of 74.2° F., while the mean for August is only 2° F. lower.

There is a range in temperature of 58.6° F. between the means of the coldest and warmest months. The lowest temperature recorded is -35° F. in January and the highest 107° F. in July.

The average date of the last killing frost in the spring is April 28 and that of the first in the fall, October 2. This gives an average growing season of 157 days which is ample for the maturing of ordinary farm crops. Killing frost has occurred, however, as late in the spring as May 21 and as early in the fall as September 13.

The mean annual precipitation is 25.96 inches, of which 10.49 inches, or 40 per cent, falls during the principal part of the growing season, June, July, and August. The total precipitation in the driest year on record is 16.85 inches and in the wettest year 41.10 inches. The

driest months are November, December, January, and February, each of which has less than 1 inch normal precipitation.

The greater part of the rainfall during the summer occurs as local storms. The precipitation in May and June is well distributed, periods of drought being practically unknown. In July the distribution is less favorable and in August and September the rainfall is lighter. Droughts occasionally occur in these three months. In general, however, the rainfall is ample for the production of crops and is so distributed that they seldom suffer during the growing season if the soil moisture is properly conserved. Serious droughts are practically unknown. The amount of snowfall varies annually from a few inches to several feet.

From October 1 to April 1 the prevailing wind is from the northwest and from April 1 to October 1 it is from a southerly direction. The average wind velocity for the year is about 9 miles an hour. Strong winds are common, though tornadoes are rare.

The relative humidity is fairly uniform, the annual average being about 70 per cent. The records show that about one-half the days of the year are clear, one-fourth cloudy, and the remainder partly cloudy.

AGRICULTURE.

Agriculture has been the chief interest in Dakota County since the earliest settlement in 1855. The immigrants first located in the level Missouri River bottom lands, where the only labor necessary to obtain crops was to break the soil, plant the seed, and cultivate. The smooth land was rapidly taken up and later settlers were forced to homestead the rougher and less desirable upland. Corn was the first crop grown and was followed by small grains and other subsistence crops.

The first farmers in this region were crude and wasteful in their methods, little attention being given to the preparation of the seed beds and to seed selection, crop rotation, and fertilization. At present the tendency is to improve the crops by careful seed selection and to increase the productive capacity of the soil by crop rotation, manuring, and growing leguminous crops, such as alfalfa and clover.

The agriculture of Dakota County now consists of diversified farming, principally production of corn, oats, wheat, barley, potatoes, and alfalfa for sale, for stock feeding, and for home consumption together with dairy farming and stock raising. Specialized farming is carried on locally where groups of farmers raise truck crops for the local markets.

The following table compiled from the reports of the Bureau of the Census shows the trend of agriculture during the four census periods from 1880 to 1910:

*Acreage and production of principal crops during last four census periods.
1880-1910.*

Crop.	1880		1890		1900		1910	
	Acres.	Bushels.	Acres.	Bushels.	Acres.	Bushels.	Acres.	Bushels.
Corn.....	11,820	496,465	27,775	991,500	39,646	1,408,080	49,875	2,051,300
Oats.....	1,359	35,964	4,428	127,776	5,835	186,470	15,463	409,500
Wheat.....	9,019	83,468	3,057	52,527	28,722	396,360	8,885	113,217
Rye.....	10	137	35	670	38	710	4	80
Barley.....	81	1,357	400	6,810	877	26,480	1,421	25,738
Beans.....		122		85	14	239	2	4
Flaxseed.....		6	429	3,970	126	950	50	400
Potatoes.....		33,654	645	53,245	1,215	165,693	1,907	142,798
		Tons.		Tons.		Tons.		Tons.
Timothy.....							665	999
Clover.....					21	43	48	81
Timothy and clover mixed.....							1,704	2,991
Alfalfa.....							1,888	5,370
Wild salt, and prairie grasses.....	10,504	21,090	18,989	32,813	8,188	12,735	7,171	13,151
		Trees.	Bushels.	Trees.	Bushels.	Trees.	Bushels.	
Apples.....		4,815	5,145	20,618	4,313	21,232	41,136	
Peaches and nectarines.....				25		30		1

It will be noticed that the acreage planted to corn, oats, barley, and potatoes steadily increased between 1880 and 1910. The wheat acreage, however, fluctuated considerably. The acreage of wild hay grasses has decreased and been supplanted with cultivated varieties. According to the table the number of fruit trees steadily increased between 1880 and 1910.

In the following table are given the more important agricultural data relating to Dakota County, as compiled by the Bureau of the Census for the four census years, 1880 to 1910:

Agricultural data for Dakota County for the census years 1880-1910.

	1880	1890	1900	1910
Number of farms.....	424	571	743	787
Land in farms.....acres.	88,027	118,370	152,077	148,046
Improved land in farms.....do.	60,399	93,719	99,439	129,236
Average acres improved land per farm.....	142	164	139	164
All property, per farm.....	\$3,239	\$6,005	\$8,022	\$16,933
Land, fences, and buildings.....per cent.	69.20	79.30	79.90	78.60
Implements and machinery.....do.	4.70	2.80	3.30	2.30
Domestic animals.....do.	26.00	17.80	16.60	10.10
Cost of fertilizers.....	\$802		\$5,140	\$410
Cost of labor.....			\$78,570	\$172,864
Farms operated by owners.....per cent.	84.40	77.06	64.20	57.10
Farms operated by tenants.....do.	15.60	22.94	35.30	42.40
Farms operated by managers.....do.			.50	.50

The above table shows an increase in the number of farms in the farm area and in the area brought under cultivation, together with a general increase in the value of all farm property. Also a decrease in the number of farms operated by the owners and an increase in tenant farming.

Corn is easily the predominating crop, and on farms where it is not fed to live stock it is the chief cash crop. It occupies an acreage almost as large as that of all other crops combined. In 1918¹ corn was planted on 33,441 acres, with a production of 1,237,317 bushels, or 37 bushels per acre. The yields average somewhat higher on the Missouri River bottoms, being about 40 bushels per acre. The greater part of the corn is fed on the farms to hogs, beef cattle, work stock, and dairy animals, a considerable quantity being grown for ensilage. The crop is raised on nearly all soils of the county, preference being shown, however, to those of the bottom lands on account of their higher yields. Reids Yellow Dent is the leading variety, while Leads, Leaming, Wimpels Yellow Dent, and Iowa Silvermine are grown quite extensively. Yellow corn seems to be more popular than white.

In 1918 wheat ranked second in acreage to corn. This is somewhat unusual, however, and has not previously occurred for a considerable period. During normal times oats ranks second to corn. The prevailing high prices and strong demand for wheat have caused the farmers greatly to increase its acreage during the last few years. The report of the Nebraska State Board of Agriculture shows 18,396 acres devoted to wheat in 1918. Over 90 per cent of this acreage was sowed to the spring varieties, as there is generally not sufficient moisture in the fall to give proper germination and growth; also larger acreage is available for spring than for winter wheat, as much of the corn land is not ready in time for fall seeding. Spring wheat averages about 19 bushels per acre. Marquis and Velvet Chaff are the principal varieties. Turkey is the chief winter wheat, the yield averaging 18 bushels per acre. A small quantity of wheat is consumed locally, but most of the production is sold to elevators, which are operated in all railroad towns in the county.

In 1918 13,773 acres were in oats, with an average yield of 35 bushels per acre. Swedish Select (Wisconsin No. 4) is the principal variety, but Kherson, an early, short, stiff-strawed oat, has given excellent results on the heavy bottom-land soils. Only a small proportion of the oat crop is sold, most of it being fed on the farms to work stock and other animals.

The report shows 1,047 acres in barley in 1918, from which an average yield of 33 bushels per acre was obtained. Almost the

¹Rept. Neb. State Board of Agr. 1918.

entire production of barley is fed to horses, hogs, and cattle, very little being sold.

Of the hay crops, alfalfa occupies the largest acreage, even exceeding that devoted to wild hay. In 1918 there were 6,673 acres in alfalfa yielding three tons per acre from three cuttings. Its high feeding value and its beneficial effects upon the soil make it a very desirable crop. Most of the alfalfa is fed on the farms to beef and dairy cattle, some is used as hog pasture.

The acreage in wild hay is decreasing in Dakota County. Very little of the Missouri River bottoms, except those bodies where drainage is insufficient for cultivated crops, remains in wild hay, and no doubt, even these areas will, in a few years, be devoted to grain growing. In 1918 there were 4,188 acres in wild hay with an average yield of 1.4 tons per acre.

Potatoes were planted on 1,011 acres and gave an average yield of 80 bushels per acre in 1918. The principal varieties are Early Ohio and Everts. Most of the crop is used locally.

A small acreage in the northern part of Dakota County is given to the production of truck crops, such as watermelons, cantaloupes, pumpkins, squashes, cucumbers, tomatoes, and onions. Where soil conditions are favorable these crops yield good returns, as the area in which they are grown lies but a short distance from Sioux City, an excellent market for such produce.

The less important crops of Dakota County are rye, emmer, millet, sorghum, timothy, and clover. Timothy and clover mixed was a rather important crop in 1910, but has greatly decreased in acreage since that time. Nearly every farm has a few fruit trees, but there is seldom a surplus of fruit for sale. Apple, peach, plum, pear, and cherry trees are the most common. Strawberries, blackberries, raspberries, and grapes are grown on a few farms for home use. Of the wild fruits, grapes and plums are quite plentiful. A few walnut trees occur on the dissected belt along the bluffs in the central part of the county.

Hog raising is probably the foremost animal industry in Dakota County. According to the census 20,525 hogs were sold or slaughtered in 1910. The Nebraska State Board of Agriculture reports 17,242 hogs in the county on April 1, 1918. Almost every farmer raises hogs in greater or less number. It is the common practice to fatten the animals on corn either in feeding yards or by turning the stock in the fields and allowing them to "hog down" the corn in the fall of the year. Alfalfa is often added to the ration. The principal breeds are Duroc-Jersey, Poland-China, Hampshire, and Chester White. Although there are few purebred herds, the quality of the stock in general is very good. After providing for home needs hogs are shipped to the Omaha Stock Yards.

The raising of beef cattle in Dakota County is given only moderate attention, though nearly every farm has a small herd. Many farmers ship in stock for winter feeding. Some purebred bulls have been introduced in recent years to improve the stock. Most of the feeders are grades, showing good Hereford and Shorthorn breeding. The finished cattle are shipped to the Omaha markets.

Dairying is gradually being extended in Dakota County, as the proximity of the area to Sioux City makes conditions ideal for the dairy industry. Cream routes are in operation, and nearly every farmer has a separator. The surplus cream is either hauled by wagon or motor truck to Sioux City or shipped there by rail. Holstein cattle form the most of the dairy herds. A few herds are purebred, but most of them are composed of grade cows headed by a purebred male. Many cows of the types commonly recognized as beef breeds also are milked. There are usually but 3 or 4 cows on a farm, though in some cases as many as 10 or 12 are kept. According to the report of the Nebraska State Board of Agriculture there were 2,069 milk cows and 9,780 other cattle in the county on April 1, 1918.

Horse raising is for the most part confined to the breeding of the work mares. Much improvement has been made in horse breeding in the last 10 years, and the quality of the horses is now high, most of the stallions being purebred, while the majority of the mares are grades. The Percheron is the most popular breed. A few mules are raised on many of the farms. On April 1, 1918, there were 4,777 horses and 486 mules in Dakota County.

Sheep raising receives but little attention, and there are only a few flocks in the county, but increased interest is being displayed in small breeding flocks. Some feeders are imported each fall, fattened on corn and pasturage and shipped to Omaha when the market is favorable. There were 891 sheep in the county in 1918.

Poultry is kept on all farms and constitutes an important source of income. There is a good demand for poultry products in Sioux City, and increased attention is being given to improvement of the stock. The Plymouth Rock and Rhode Island Red are the principal breeds. Ducks, geese, and turkeys are raised to a small extent. The report of the Nebraska State Board of Agriculture shows 56,688 fowls of all kinds in the county in 1918.

The adaptation of certain soils to particular crops is observed to some extent by the farmers. It is recognized that most varieties of oats do better on the upland soils than on the heavy soils of the bottom land, where they are likely to lodge. The Kherson oats, however, a very short, stiff-strawed variety, has given excellent results on the heavy soils. It is recognized that corn does better on the dark-colored Marshall silt loam than on the light-colored Knox silt loam, and produces the highest yields on the well-drained bottom-land soils.

The light sandy textured first-bottom soils in the northeastern part of the county are better adapted to truck crops than to grain production. Fruit trees seem to do best on the slopes in the uplands. While the above crop adaptations are recognized, there is not sufficient variation in the yields in different parts of the county to cause specialized farming under the conditions existing except on the soils adapted to truck crops.

No definite rotation is followed in the local cropping systems on account of the increasing acreage of alfalfa, this crop usually remaining on the same field for seven or eight years after seeding. A common rotation is corn followed by small grain or alfalfa. Where alfalfa is plowed up it is usually followed by corn for two years, and where potatoes enter the rotation corn is planted but one year and followed by potatoes. Corn is often kept on the same land from two to four years followed by one year of oats and one or two years of wheat. A rotation which seems to have merit is two years of corn, one year of oats, rye, or barley, one or two years of wheat, and four to six years of alfalfa.

The prevention of erosion is an important problem in the upland sections of Dakota County, numerous areas having been exhausted of their organic matter by surface wash even within the short time that the hilly section has been under cultivation. Considerable surface soil is washed from the hills and deposited at the foot of slopes after each rain, and scarcely any preventive measures have been taken to correct this condition.

Only moderate attention is given to the proper cultivation and fertilization of most of the crops. Land intended for winter wheat is generally plowed in the fall just before seeding and the seed bed prepared with a harrow and disk, little time being allowed for the proper aeration and settling of the soil between plowing and sowing. Wheat is usually drilled in, though sometimes sown broadcast and covered with a harrow. Some wheat is drilled between the corn rows in the fall of the year. The method of preparing the land for spring wheat varies. Where the crop follows corn the seed bed is sometimes simply disked before sowing, but usually the land is plowed, disked, and harrowed.

Land to be put in corn is generally plowed in the spring to a depth of 6 or 8 inches and is disked or harrowed two or three times before planting. The greater part of the corn is check planted. The crop is cultivated three to five times. When corn succeeds itself, if the previous year's crop has not been cut for fodder or silage, the stalks are broken down with a stalk cutter and the field disked before plowing.

Potatoes generally follow corn, though little attention is given this crop, as it is seldom grown commercially. It is sometimes

planted on stubble ground after the soil has been plowed deeply and well pulverized. The seed is generally dropped by hand. The crop is harvested during the latter part of September. A few horse-drawn potato diggers are used in the county, but most of the crop is dug with an ordinary stirring plow or lister and the tubers picked by hand.

Alfalfa requires a smooth, mellow seed bed and is usually planted after wheat. The seed is generally sowed broadcast and harrowed in, though many farmers prefer planting with a press drill, which gives generally a more uniform stand. Alfalfa does best when sowed immediately after the first good rain in August from 12 to 15 pounds of seed per acre being considered sufficient.

The special crops, such as watermelons, cantaloupes, cucumbers, and tomatoes, are planted on a deep, mellow seed bed, in which much manure has been incorporated. These crops can be cultivated with teams only during their early growth, later hoeing and weeding being done almost entirely by hand.

In harvesting, corn is generally shucked and hauled to bins for winter feeding. During recent years silos have become quite numerous and many farmers use corn harvesters to cut part of the crop for ensilage. Over a small part of the acreage the corn is snapped and the stalks pastured, while some farmers "hog down" a small acreage each year.

The small grains are cut with a binder, shocked, and later stacked, the grain being thrashed in the late summer or fall by local thrashing outfits traveling from farm to farm. Hay is either stacked or stored in barns, very little being baled.

With few exceptions the farm improvements in Dakota County are exceptionally good, the buildings, especially the houses, being usually well painted and kept in good repair. Nearly all farms are fenced and cross fenced, mostly with barbed wire, though many farms are inclosed with "hog-tight" woven-wire fencing. The work stock consists of medium to heavy draft horses and mules. Several tractors are in use in the bottoms and on the more level portions of the upland. Modern labor-saving machinery is in general use over the entire county, most farms being equipped with manure spreaders, grain drills, mowers, rakes, binders, riding cultivators, and disk harrows, while a few have in addition corn binders and hay balers. As a rule the farm machinery is not sheltered.

Practically no commercial fertilizer is used. Considerable barnyard manure is produced, but there are no manure pits and on most farms it is piled out of doors without protection where much of its fertilizing value is lost by leaching. The manure is hauled in the spring and fall and generally broadcasted on land to be plowed for corn or wheat. The land in the immediate vicinity of the barn-

yard usually receives the largest percentage of the manure; especially is this true on the tenant farms.

Farm labor is scarce. Wages range from \$50 to \$75 a month with board and room. Day labor commands from \$3 to \$4 a day, while harvest hands are sometimes paid \$6 a day with board. Corn shuckers receive 6 to 8 cents a bushel. The farm laborers are all white. Many farmers hire help by the year and in this way insure against lack of labor at critical periods.

The census reports 148,046 acres, or 91.4 per cent of the county, in farms in 1910. The average size of the farms at that time was 188.1 acres, and an average of 164.2 acres, or 87.8 per cent, of the farm land was improved. At the present time the farms range in size from 80 to 320 acres, and practically all the land is improved.

In 1910 the percentage of farms operated by owners was 57.1. This percentage has decreased during the last few years, and at the present time there are probably more tenants on land than owners in Dakota County.

The cash system of land rental is most common, and leases generally cover only one year. The rent varies widely, ranging from \$8 to \$12 an acre in the upland and from \$12 to \$15 an acre on the bottom-land areas. Under the share-rent contracts, the tenant usually furnishes all equipment, labor, and seed and receives from two-fifths to one-half of the crops. On a few farms the tenant is required to give three-fifths of the produce and \$3 an acre cash rent.

Land values range from \$125 to \$400 an acre, with an average of about \$275 an acre for the county as a whole. The lowest priced land is that in the rough dissected belt along the bluffs bordering the Missouri River bottoms and along the river where land is likely to suffer destructive erosion with the meandering of the stream. The highest-priced land is in the bottom lands in the central part of the county.

Dakota County contains considerable forest within its boundaries, about 4 per cent of the total area being covered with deciduous trees. The narrow first bottoms along the streams of the upland support a fairly dense growth of elm, ash, oak, cottonwood, and willow. Some cottonwood, willow, elm, and box elder are found along the abandoned channels of the Missouri River, and a fairly dense growth of small willows on the sand and silt bars along the banks of the stream. The bluffs and sharply eroded areas bordering the Missouri River bottoms are covered with a dense strip of timber varying in width from one-fourth to 1½ miles, consisting largely of elm, ash, box elder, oak, basswood, and scattering trees of bitter hickory, walnut, and hackberry. The underbrush in these areas is made up of sumac, dogwood, ironwood, and small patches of hazel.

brush, and blackberry. There is much less timber at the present time than in the early history of the county, as it has supplied more or less of the building material and fuel since the first settlers arrived.

SOILS.

Upon the basis of physiographic position the soils of Dakota County may be divided into three groups—upland, colluvial slope, and first-bottom soils. The upland group embraces the Knox and Marshall series; the colluvial slope group, the Judson series; and the first bottom group the Wabash, Cass, and Sarpy series, and River-wash.

The upland soils are loessial in origin. The colluvial slope soils represent valley-filling deposits and consist of reassorted loesslike material. The first bottom soils represent alluvium, derived from the adjoining uplands and from the Missouri River drainage area on the north and west.

The entire county was originally covered with a thick mantle of loess and presented a more or less level plainlike topography. The loess deposit now varies in thickness from a very thin mantle to about 80 feet. It is thickest on the broad divides and thins out on hillsides toward the valley floors. It is composed largely of silt with a very small percentage of very fine sand and some clay. The material ranges in color from yellow or pale yellow to light gray, and is always more or less impregnated with lime and mottled with iron stains. It characteristically stands almost vertically in cuts, though it readily crumbles and caves under the action of running water, forming deep-sided V-shaped draws. The deeply weathered loess beds give rise to the Marshall silt loam and where the surface soil has been eroded to the Knox silt loam.

It is the opinion of the geologists of the Nebraska soil survey² that the original material was carried to its position by sluggish streams during one or more of the later glacial advances into Minnesota, Iowa, and South Dakota, the material consisting of fine glacial outwash more or less mixed with materials deposited by streams coming from the northwest.

Erosion and weathering has destroyed the original constructional surface of the loess until it now has a destructional configuration, the dissection varying from a depth of about 350 feet along the bluffs in the eastern part of the county to about 200 feet on the western boundary. The cutting down along the larger streams extends through the loess into the underlying glacial drift, and in the bluffs bordering the bottom lands the dissection in places has reached through the drift and into the Dakota sandstone.

² G. E. Condra, Annual Report, Nebraska State Board of Agriculture, 1914, pp. 262-283.

As the loess has been carried down the slopes by creep and washing, practically none of the drift is exposed except where there has been recent active erosion.

The glacial geology of the county has not been definitely worked out by the State geologists, and hence only general statements can be made. Directly underlying the loess are three distinct drift sheets, of which the Kansan is the uppermost, the Aftonian the intermediate layer, and the Nebraskan the lowermost. In Dakota County only the Kansan sheet is exposed. It occurs along the lower slopes of the deeper valleys where there has been pronounced recent erosion. It is distinctly till and consists of a heterogenous mass of clay, silt, sand, gravel, and boulders. Where oxidized it has a yellowish, brownish, or reddish-brown color, but in the lower part it is light gray or bluish. With the Kansan drift are associated sand beds whose exact geological history is not known.

The Aftonian material consists largely of stratified sands and gravels, with few boulders. The lowest drift sheet, the Nebraskan, consists of blue clay containing small pebbles and boulders.

The oldest consolidated rocks exposed in the county are of Cretaceous age. They consist largely of Dakota sandstone, which includes some clay and slate with lignite deposits. Outcrops are found along the bluffs about 1 mile north of Homer. Aside from its water supplies the Dakota sandstone is of little economic importance. Though quite friable it is sometimes used for building purposes. It does not give rise to any arable soil types and has been mapped as rock outcrop in the survey. Locally the Benton formation rests on the Dakota, though its extent is not known.

Typical terrace or second-bottom soils are not developed in Dakota County as the upland loess usually borders the flood plains. Along a few of the streams, however, narrow strips of colluvial-slope soils have developed which consist of reassorted loessial material washed down from the uplands and deposited in the narrow valleys. This material gives rise to the Judson silt loam. It lies from 10 to 15 feet above the bottom-land soils.

The recent alluvium or first-bottom soil material comes from two main sources. That along the smaller streams is derived from local upland material. It is very uniform in texture and color and consists largely of silt washed from the Marshall and Knox types. It is dark brown to black in color and is classed with the Wabash silt loam.

Along the Missouri River the alluvium is composed largely of alternate layers of silt, very fine sand, and clay, varying in color from grayish brown to black. In some places the material is loose and friable, while in others it is close in structure and tenacious. It is derived not only from the adjoining uplands but also from more distant areas.

The recent alluvial material is thus complex. When the stream carries sediment of a variety of textures, the coarser material is deposited near the channel and the finer farther back, owing to the assorting power of the currents of varying velocities. In places, however, fine material is found near the stream, this being due to a comparatively recent change in the position of the channel. The same cause sometimes results in a light-textured layer overlying heavy-textured material. Strata of widely varying textures may thus overlie one another, dependent on the course of the stream during the time of deposition.

The alluvial soils of the Missouri River are classed with the Wabash, Cass, and Sarpy series. The sand, silt, or clay bars and flats lying immediately along the river are mapped as Riverwash.

The Marshall soils are dark brown. The subsoils are yellowish brown to brownish yellow, porous, and friable, little, if any, heavier than the surface soils, and usually calcareous. The types of this series differ from those of the Knox series in the relatively large quantity of organic matter in the surface soils. The topography is rolling, and drainage is generally adequate for the best results with crops.

The types included in the Knox series prevailingly have light-brown soils and yellow or light grayish yellow subsoils. They are derived from loess, the deposits where the Knox series is found always being thick enough to form the subsoil as well as the surface soil, and the deeper lying glacial till being far enough from the surface to have no marked influence on the general character of the soil. The topography is rolling to hilly, and the surface drainage in many places is excessive.

The Judson series comprises soils of alluvial and colluvial origin. The surface soils of these types are dark brown and the subsoils are somewhat lighter brown, and there is no great difference in texture between soil and subsoil. Neither the soil nor the subsoil is highly calcareous. This series is found on terraces above overflow and on colluvial slopes at the foot of bluffs. The soil material is mainly wash from loess or silty drift soils. The soils usually occur in association with the Knox and the Marshall series of the upland.

The Wabash soils are prevailingly black, ranging to dark brown, and contain a high percentage of organic matter. The subsoils are gray to brownish gray or mottled. These soils are developed in the first bottoms of streams in the Central Prairie States and extend for long distances along the Missouri River. The material is derived principally from the loessial and associated soils of the region. They have a flat topography and in many places are poorly drained.

The surface soils of the types included in the Cass series are prevailingly dark brown to black and the subsoils lighter in color and

in texture. These soils are alluvial, and most extensively developed in the bottoms along the Missouri River and its tributaries. They occur in association with the Sarpy and Wabash soils and in a few places are subject to overflow. Drainage, however, is generally good.

The Sarpy series includes brown soils, underlain by subsoils of lighter texture, frequently passing within the 3-foot section into loose sand and gravel. Both soil and subsoil are calcareous. The series occupies first bottoms subject to overflow. It differs from the Cass series only in the lighter color of its surface soils.

In the following pages of this report the soils of Dakota County are described in detail and their relation to agriculture discussed. The accompanying map shows their distribution in the area. The following table gives the name and the actual and relative extent of each soil type mapped:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Marshall silt loam.....	69,696	42.2	Cass silt loam.....	4,672	2.8
Knox silt loam.....	28,480	17.3	Wabash silty clay loam.....	4,608	2.8
Sarpy very fine sandy loam.....	14,976	9.4	Judson silt loam.....	3,712	2.2
Poorly drained phase.....	576		Cass clay.....	2,624	1.6
Wabash clay.....	15,232	9.4	Sarpy fine sandy loam.....	2,432	1.5
Poorly drained phase.....	320		Rock outcrop.....	768	.5
Wabash silt loam.....	6,592	4.0	Total.....	165,120	-----
Cass silty clay loam.....	5,312	3.2			
Riverwash.....	5,120	3.1			

MARSHALL SILT LOAM.

The surface soil of the Marshall silt loam is a dark-brown moderately heavy silt loam, passing gradually into a layer of brown, slightly heavier silt loam from 2 to 6 inches thick, which grades into a yellowish-brown, more compact, heavy silt loam, with no apparent accumulation of clay. Below about 30 inches the subsoil becomes looser in structure and is often mottled with light-gray and reddish stains, the color becoming more pronounced with depth. The depth of the surface soil depends largely upon the topographic position. On flat divides and slopes it is usually 15 to 18 inches deep, becoming deeper toward the base of the slopes, while on sharp divides and shoulders of hills it seldom exceeds 10 or 12 inches. The soil is high in organic matter and has a smooth velvety feel. The boundary line between the soil and subsoil is marked by a gradual change in both color and texture. The structure of the upper part of the subsoil is granular, while that of the lower part, together with the substratum, is columnar. The subsoil is highly calcareous, the lime existing

chiefly in the form of concretions, but occasionally none are encountered in the 3-foot section. The Marshall silt loam is derived from the eroded plains loess that at one time capped the entire county.

Narrow strips of colluvial material too small to be indicated on the map were encountered along intermittent streams. Upon the shoulders of hills and along gullies, where erosion has been severe, small spots of Knox silt loam occur, which were too patchy to be indicated satisfactorily on the map. The progress of erosion tends to increase the extent of Knox silt loam at the expense of the Marshall silt loam. Occasionally within the areas of Marshall silt loam small bodies containing an appreciable quantity of sand and gravel occur, but these were so scattered and of such small extent that they could not be shown satisfactorily on the map.

The Marshall silt loam is the most extensive soil type in Dakota County, occurring throughout the upland division. The bodies are generally continuous, though thickly dotted with areas of Knox silt loam. The most uniform bodies lie in the south-central part of the county, the percentage of Knox silt loam increasing northward.

The topography of the type varies from undulating to steeply rolling. In general the slopes along streams are rather steep, while those within the divides are gentle. The greatest relief occurs in the northern part of the county and along the bluffs bordering the Missouri River bottom where the slopes are in some places precipitous. Another steeply rolling body lies south and west of Blyburg Lake in the southeastern part of the county. In these areas the slopes are generally steep and the divides narrow and crestlike. Areas of gently undulating topography occur in the south-central part of the county; elsewhere the relief is gently rolling to rolling.

Drainage on the Marshall silt loam is everywhere adequate, and in most places excessive, erosion being a serious factor on many farms of this type. The soil retains moisture well, owing to its high organic matter content, friable structure, and silty texture, and it withstands drought over prolonged periods. Little moisture is lost through subterranean drainage.

The Marshall silt loam does not produce quite as high yields as some of the bottom-land types and is more subject to injury by erosion, but its larger acreage tends to make it the most important agricultural soil of the county. It was originally covered with a thick growth of prairie grasses common to this general region, but only a few scattering patches of the original sod remain. Along the drainageways and in the bluff belts it was forested. Considerable timber is left, and where not disturbed it is becoming more extensive. Bur oak (*Quercus macrocarpa*), red oak (*Quercus rubra*), basswood (*Tilia americana*), white elm (*Ulmus americana*), hackberry (*Celtis occidentalis*), and black walnut (*Juglans nigra*), together with an

undergrowth of sumac, dogwood, and hazelbrush, constitute the native vegetation in the forested areas.

About 90 per cent of the type is in cultivation, the remainder being used for pasture, wood lots, roads, and farm buildings. Most of the unimproved land is in the belt of rough topography lying along the bluff line. About three-fifths of the improved land is in corn, and the remainder is largely devoted to wheat, oats, and alfalfa, ranking in acreage in the order named. Timothy and clover mixed were formerly grown quite extensively, but have been largely displaced by alfalfa during recent years. The chief objection to alfalfa is that it does not fit in a rotation as well as clover, but its higher yield has tended to offset this objection and it is now the principal tame hay crop on the type. Some potatoes and other vegetables are grown on nearly every farm, and there are a few small apple and peach orchards, but no special crops are grown commercially on this type. Wheat is the principal cash crop, as most of the corn produced is used to feed stock, while the fruit and vegetables grown are consumed on the farm.

The live-stock industries on this type consist of the raising of hogs and beef cattle and the fattening of steers. A few sheep are raised, and some are shipped in for feeding. Dairying is not widely developed, although nearly every farm has a few milk cows and some farmers own good dairy herds. There are several cream routes, and the surplus cream is hauled direct to Sioux City or to the nearest railroad for shipment to that city.

Corn yields from 25 to 50 bushels, with an average of about 30 bushels per acre, while in some exceptional years as much as 90 bushels per acre have been obtained. When it is planted more than two years in succession on the same land without applying manure the yield falls off appreciably. Oats return 30 to 40 bushels per acre. This crop, as a rule, does better on the Marshall silt loam than on the heavy bottom-land soils, where it is likely to grow rank and lodge.

Winter wheat yields better on this type than spring wheat, although it is not grown so extensively as the latter, because the corn land can not be prepared in time for fall planting. Winter wheat yields 20 to 25 bushels and spring wheat 15 to 18 bushels per acre. During recent years under the stimulation of war conditions the acreage of corn land has been steadily decreasing and that of winter wheat increasing. Alfalfa does exceedingly well on this type. Three cuttings and occasionally four are obtained, with a total yield of 3 to 4 tons per acre. The stand is usually maintained from five to seven years and in some instances longer, but it generally begins to deteriorate rapidly about the seventh year and the land should then be plowed and used for other crops.

A small quantity of sorghum is occasionally grown. The grain varieties yield about 35 bushels per acre. Some saccharine sorghum is also grown, the ordinary yield of sirup being about 90 gallons per acre. Most of the sorghum acreage, however, is cut for fodder. In normal years the average yield is approximately 8 tons. The tendency on the Marshall silt loam is to grow less corn and more wheat and alfalfa and to raise more live stock.

While as yet scarcely any definite rotation is practiced, the farmers are directing more attention to this matter than in former years. The usual plan is to grow corn two to three years, oats one year, and wheat one to two years, returning then to corn. Alfalfa is often planted on wheat ground.

Owing to its friable structure, freedom from stones, and silty texture, the Marshall silt loam is very easy to handle. It can be cultivated under a wide range of moisture conditions, for though it has a tendency to clod if plowed when wet, the clods are easily reduced. Three or four horses are used in plowing and in performing most of the other farm work.

No commercial fertilizer is used, but barnyard manure is applied when available and usually increases the yields from 15 to 20 per cent.

Land values on this type range from \$100 to \$250 an acre, averaging about \$200. The price depends largely upon the topography and, to a smaller extent, upon improvements and location.

Under the present system of grain farming, without adequate provision for maintaining the organic content of the soil, the productiveness is gradually decreasing. This is especially true on the farms operated by tenants. The soil is ideally adapted to clover and alfalfa, and these crops should be grown much more extensively, as they not only add needed organic matter but also nitrogen to the soil. Fall plowing should be more generally practiced where there is little danger of erosion. Where the soil is likely to wash, steps to prevent it should be taken. Deeper plowing and keeping the steeper slopes in cover crops as much as possible are important means to this end. After gullies have been formed the prevention of erosion becomes more difficult. Low dams made of stone, earth, weighted brush, or rubbish should be placed at intervals along the gully to impede the flow of water and collect its load of sediment.

KNOX SILT LOAM.

The Knox silt loam consists of a light-brown to grayish or yellowish-brown, loose, friable silt loam, 6 to 10 inches deep underlain by a yellow or light yellowish brown, heavy silt loam, which at 24 to 36 inches passes into a light-brown somewhat looser stratum.

Reddish-yellow iron stains and white lime concretions are encountered below 15 inches. In the typical soil there is no apparent difference in texture or structure between soil and subsoil. The depth and color of the surface soil varies with its topographic position. On the more level areas of its occurrence the soil sometimes extends to a depth of 12 inches and is brown in color, while on narrow ridges and along gullies where erosion is severe the surface material is light gray in color and extremely shallow. The soil has a smooth, floury feel, and, as the color indicates, is very low in organic matter. The material in general has a pronounced open and columnar structure. The entire 3-foot section is high in lime, and where erosion has been severe, lime concretions are plentiful on the surface.

On virgin prairie and forested areas and on the lower slopes of hills the soil is dark in color, approaching the Marshall silt loam type in character. In the bluff zone it is somewhat coarser in texture and more friable than farther west and considerable sand blown from the Missouri River Valley has been mixed with the soil in this section. The Knox silt loam represents weathered upland loess from which the surface soil containing black organic matter has been removed by erosion almost as rapidly as it was formed.

The type, as a rule, occupies the highest positions in the upland parts of the county. It occurs within areas of Marshall silt loam, as irregular bodies varying in size from a few acres to several square miles. The largest areas occur in the northwestern part of the county, one of the most extensive and uniform lying along the bluff line north of Willis and Jackson, and another south of Willis.

The Knox silt loam is confined chiefly to narrow ridges, hilltops, and steep slopes between the areas of Marshall silt loam and the bottom lands. The topography is rolling to hilly, with the divides and hilltops well rounded. Along the bluff zone the type is deeply dissected by short streams, the valleys of which are distinctly V-shaped and the intervening divides very sharp.

In general the type is thoroughly dissected and the drainage naturally excessive. It is subject to severe erosion during heavy rains, but as the subsoil material is productive after aeration and the incorporation of a little organic matter the effect of erosion has not been keenly felt. Considering its low content of organic matter the soil is remarkably retentive of moisture.

Owing to its large extent the Knox silt loam is an important agricultural soil in Dakota County. About 70 per cent of it is under cultivation, the remainder being used for pasture. In its natural condition, where not severely eroded, it is covered with a dense growth of native grasses, chief among which are the big and little bluestem. Along the bluffs there is considerable timber of the same species as occur on the Marshall silt loam, with bur oak predominating. The

staple crops of the county are grown, corn, wheat, oats, and alfalfa ranking in acreage in the order named. Where the soil is not manured yields are considerably lower than those obtained on the surrounding Marshall silt loam, but where manure is applied crops give about the same returns as on manured land of the latter type. The soil, on account of its thorough drainage and high lime content, is especially suited to alfalfa. Corn yields from 20 to 30 bushels, wheat 10 to 15 bushels, oats 20 to 30 bushels, and alfalfa 3 to 4 tons per acre from three cuttings. Potatoes, where the land is manured, are said to do better than on the Marshall silt loam, yielding from 75 to 175 bushels per acre.

The soil is not so easy to handle as the Marshall silt loam, chiefly on account of its rougher topography. The Knox is also more sticky than the Marshall, owing to its low organic-matter content, and can not be cultivated under so wide a range of moisture conditions. Where there are several types of soil in the same farm, the Knox silt loam usually receives all the barnyard manure though there is seldom a sufficient supply to maintain productiveness at the maximum.

The selling price of the type ranges from \$175 to \$225 an acre, depending upon the topography and improvements.

The soil is naturally low in organic matter and its productiveness is gradually decreasing under the present methods of farming. More acreage should be devoted to leguminous crops, to which the type is so well adapted. Erosion on this soil is becoming serious and efforts should be made to lessen its damaging effect by growing winter cover crops and by checking the wash in gullies. The type is recognized as one of the strongest fruit soils in the United States and in this region is well adapted to apples, grapes, strawberries, and blackberries. With a ready market in Sioux City it would appear that fruit growing could be profitably extended on this soil in Dakota County.

JUDSON SILT LOAM.

The Judson silt loam consists of a brown to dark-brown, loose, friable silt loam, 10 to 15 inches deep, resting on material of about the same texture, but of variable color to a depth of 36 inches. On most of the type the subsoil is slightly lighter colored than the surface material, owing probably to a lower organic-matter content, but in the vicinity of Goodwin it is dark brown to almost black and slightly heavier than the surface soil. In a few places the subsoil is light brown. The soil is the result of colluvial action, although in many places it has been considerably modified by alluvial deposits and much resembles terrace or bench land. It is of comparatively recent origin and sufficient time has not elapsed for the development of zonal differences in the material.

The type is not extensive. It occurs chiefly along the valley slopes in the upland parts of the county. Small bodies, seldom of sufficient size to map, lie along the bluffs bordering the Missouri River bottom. One of the most extensive areas occurs along Elk Creek in the vicinity of Willis.

The Judson silt loam lies from 15 to 30 feet above the normal flow of the streams to whose banks it in many places extends. The surface is almost flat, though it generally has a decided slope toward the streams, and drainage is good.

This soil is rather unimportant in Dakota County, owing to its small extent, but in other counties, where it occurs more extensively, it is a very valuable soil, being equally as productive as the Marshall silt loam. About 90 per cent of the type is under cultivation in this county, the rest being used for pasture and for the production of hay. The native vegetation consists of a thickly matted growth of grasses. There is practically no forest growth.

Corn, wheat, oats, and alfalfa are the most important crops, ranking in acreage in the order named. The growing of alfalfa is being extended. Potatoes and other vegetables are grown to supply the home demand.

Corn gives an average yield of 30 bushels per acre; wheat, mostly spring varieties, 18 to 25 bushels; oats, 30 to 40 bushels; and alfalfa, 3 to 5 tons from three cuttings. All vegetables do well; potatoes yield from 75 to 200 bushels per acre.

The fattening of steers is engaged in rather extensively, while hogs are raised on nearly every farm, and a few sheep are shipped in for feeding. All farmers have some dairy and poultry products for sale.

The Judson silt loam is somewhat easier to handle than the Marshall silt loam on account of its more nearly level topography and consequent freedom from erosion. No commercial fertilizer is used, but barnyard manure is applied when available. The soil is considered somewhat stronger than the Marshall silt loam, as with its more nearly level surface there is less loss of organic matter and other valuable soil constituents by wash.

The average selling price of this soil is difficult to determine as it usually occupies but a small percentage of the farms on which it occurs, but it has a tendency to increase the general value of these farms.

WABASH SILT LOAM.

The surface soil of the Wabash silt loam is a dark-brown to black, smooth, friable, silt loam 10 to 20 inches deep. The subsoil is compact and has a granular structure but is somewhat variable in color and texture. In localities where the surface soil is relatively shallow the subsoil is a dark-brown to black, heavy, waxy clay, differing

little from that of the Wabash clay, but where the surface material extends to a depth of 16 to 20 inches, the subsoil is lighter in texture, being a dark slate colored to black heavy silt loam to silty clay loam, in many places faintly mottled with brown. In a few places the material below 24 inches changes to a dark gray. It is slightly calcareous, and lime concretions are encountered in the lower part. Such concretions are plentiful in the deeper substratum, and may be seen in the banks of streams. The change in color, texture, and structure from soil to subsoil is very gradual, and in places there is no change within the 3-foot section except that the subsoil is more compact. Both soil and subsoil contain a large admixture of organic matter. The type is derived largely from reworked silty material deposited in the first bottoms or flood plains of streams.

The Wabash silt loam is not an extensive soil in Dakota County, occurring as scattered irregular bodies in the Missouri River bottom and as narrow strips along many of the upland streams. The largest area lies at the foot of the bluffs northeast of Hubbard, a large body occurs along Omaha Creek south of Homer, and a smaller, though very uniform area northeast of Heilman School in the east-central part of the county.

The topography of the areas bordering the smaller streams is almost flat with a gentle slope down the valleys and toward the stream channel. In the Missouri River bottoms the flat surface is here and there interrupted by old cut-offs and shallow depressions. Drainage is generally good. Most of the type lies from 10 to 30 feet above the present limits of overflow and is seldom subject to inundation. In a few places along Elk Creek high water covers the soil but causes no serious damage as it seldom remains on the land more than a few hours. Part of the area northeast of Homer does not have sufficient drainage for crop production, but this land is being rapidly reclaimed by drainage ditches. Certain small areas of Wabash silt loam which were at one time worthless for farming have been drained and now give higher yields of corn than the surrounding land.

The Wabash silt loam is an important soil. About 90 per cent of it is under cultivation, the remainder being in pasture and wood lots. The forest growth occurs mainly in the narrow first bottoms along stream channels, and consists of oak, elm, ash, cottonwood, hackberry, and some walnut. Corn, wheat, oats, and alfalfa are the leading crops. The live-stock industry is as well developed on this type as on any other soil in the county. It consists largely of hog raising and the winter fattening of steers, feeding yards often being located on the type on account of convenient water supply.

All crops give high yields on this soil except on those areas where drainage is deficient. Corn yields 50 to 60 bushels per acre, depending upon the season, and average yields of 40 bushels of oats and 25

to 30 bushels of wheat are obtained in favorable years. Short-strawed varieties of oats and spring varieties of wheat are grown chiefly. Alfalfa yields 3 to 5 tons per acre per season. The Wabash silt loam is the strongest corn soil in the county and stands continuous cropping better than any other soil except the Wabash clay.

Crop rotation is given little attention. The soil is much easier to handle than the Wabash clay and silty clay loam and can be cultivated under a wider range of moisture conditions. It does not clod so badly when plowed wet, and special care is not required to keep the soil from cracking in dry weather. The type is rich in organic matter. Manure is not used so much as on the upland soils, as with proper management it is not needed. The addition of silts washed down from the adjoining uplands tends to maintain the soil in a productive condition.

The price of land of the Wabash silt loam type ranges from \$200 to \$350 an acre, depending on the location. The large areas in the Missouri River bottom which are not cut by stream channels approach the higher figure.

WABASH SILTY CLAY LOAM.

The Wabash silty clay loam consists of a dark-brown to black heavy, silty clay loam, 6 to 12 inches deep, containing a large amount of organic matter, underlain by a heavy dark-blush to black clay subsoil, much resembling that of the Wabash clay. In places, however, the subsoil is slightly lighter in both color and texture than the typical material, being a dark-gray, heavy, silty clay, mottled with red or yellow, while in other localities the material below 12 inches is a deep, black clay which becomes heavier in texture with depth. Over small areas where the surface material consists of recent wash the subsoil is darker in color than the soil. The surface soil is somewhat sticky and plastic when wet, but breaks down easily when dry. The subsoil contains considerable organic matter and is slightly calcareous. The type is variable in texture near the margin of the areas, grading into either the Wabash silt loam or the Wabash clay. It differs from the Cass silty clay loam in having a heavier subsoil. It has been deposited in much the same manner as the soil of the Wabash clay, but its lighter texture is probably due to the large amount of silt washed down from the local upland.

The Wabash silty clay loam is one of the less extensive soils in Dakota County, its total area hardly exceeding 8 square miles. The largest body occurs south of Coburn in the central part of the area, another large and uniform body lies along the Missouri River northeast of Dakota City. Small areas occur scattered throughout the bottom land in the east-central part of the survey, and a small body was mapped along Elk Creek in the upland section of the county.

The surface of the type is almost flat, though modified in a few places by basinlike depressions. The largest area occupies part of a shallow depression and is poorly drained, but elsewhere the soil has sufficient drainage for crop production.

Owing to its small extent and poor drainage in part, the type is not important. About 50 per cent of it is under cultivation and the remainder is used for wild-hay production, slough grasses constituting the chief native vegetation. The type is a very strong soil, and where drainage conditions are good high yields of grain are frequently obtained, but the acreage of small grains has been greatly reduced, owing to the better returns from corn which ordinarily yields around 50 bushels per acre. Wheat and oats have a tendency to grow rank and as a result sometimes lodge. Wheat yields 8 to 25 bushels and oats 30 to 40 bushels per acre. Potatoes give an average yield of 100 bushels per acre. Alfalfa is grown on the better-drained areas, yielding from 3 to 5 tons from three cuttings. Prairie grasses occupy about half of the acreage of this type. From $1\frac{1}{2}$ to 2 tons of hay per acre are obtained. The hay is considerably coarser and its quality somewhat poorer than that obtained on the upland soil.

On account of its high clay content the Wabash silty clay loam can not be cultivated under a very wide range of moisture conditions. It puddles if plowed when wet, and remains in this impaired physical condition until freezing and thawing or subsequent wetting and drying of the soil restores granulation. During long droughts cracks sometimes form, causing much loss of moisture from both the surface and subsurface soil, but in general the type is retentive of moisture and crops seldom suffer from drought.

The selling price of Wabash silty clay loam ranges from \$200 to \$250 an acre, depending largely upon drainage and improvements.

The greatest need of this soil is drainage. The area lying south of Coburn is the only one in which drainage is inadequate, but as it is of relatively large extent, drainage of this area would greatly increase the production on the type.

WABASH CLAY.

The surface soil of the Wabash clay is a dark-brown to black, heavy plastic clay, 6 to 10 inches deep, containing a relatively high percentage of organic matter. The soil is hard and brittle when dry, but waxy and plastic when wet. The subsoil is somewhat variable. Over most of the area of its occurrence it is a heavy dark slate colored clay which continues throughout the 3-foot section. In some places the black color of the surface soil extends below 36 inches with no perceptible change, while in other localities the lower part of the subsoil is a dark-bluish clay, streaked with rusty-brown or

yellowish stains. Both soil and subsoil contain only a very small percentage of sand.

The lower subsoil is moderately calcareous and lime concretions are sometimes present. The dark color of the subsoil indicates considerable organic matter, and plant remains are occasionally found throughout the soil section. Well borings show that the heavy clay subsoil extends in many places to a depth of 8 to 12 feet below the surface.

The Wabash clay differs from the Cass clay in that its subsoil is darker in color and heavier in texture. The type is an alluvial soil deposited in quiet waters by the Missouri River and its tributaries, and represents flood-plain material which for the most part is above the present limit of overflow.

The Wabash clay is one of the more extensive soil types of Dakota County and occurs extensively in the Missouri River bottoms. With its poorly-drained phase it is fourth in extent among the soils of the county. The principal development is along the east side of Pigeon Creek in the east-central part of the area. A large body occurs northeast of Homer on the south side of Omaha Creek. An extensive and quite uniform area lies in the vicinity of South Sioux City. Dakota City is located on this type. The areas lie from 20 to 30 feet above the normal flow of the Missouri River.

The surface is flat, but interrupted in many places by old stream channels, shallow basins, and lake beds. With the exception of draws and low-lying areas in the vicinity of the Missouri River, the type is not subject to overflow by flood waters of that stream. Part of the type, however, near Jackson Lake and around the northern extension of Crystal Lake is in a wet marshy condition most of each year. Deep ditches have been constructed along parts of Omaha and Elk Creeks, and the land that was formerly unsuited to crops is being rapidly reclaimed. A small part of the type is subject to destructive erosion by the meandering of the Missouri River, and many farms have lost part of their acreage, and in a few places entire farms have been washed away within the last 30 years.

The Wabash clay is a very important agricultural soil, ranking first among the alluvial types. About 95 per cent of it is under cultivation, the remainder being used for pasture and for the production of hay. The native vegetation consists largely of bluestem grass. There are very few trees on this type, except where planted. Corn is the principal crop, about one-half of the type being devoted to its production. Spring wheat, oats, and alfalfa rank in acreage in the order named. Oats do not do so well as on the lighter-textured soils, as the straw grows rank and there is more or less lodging. The Kherson variety is best adapted to the soil conditions. Potatoes and other vegetables do well, but give higher yields on the sandier soils.

of the bottom lands. Cattle raising is not followed extensively, as most of the land is used for grain production. Many hogs, however, are raised and fattened on corn, and every farm has a small flock of poultry.

Corn yields from 40 to 60 bushels per acre, with much larger yields in exceptionally favorable years. Wheat yields 20 to 25 bushels; oats, 25 to 30 bushels; alfalfa, 3 to 4 tons per season. The alfalfa is cut three times, and when the growing season is unusually long four cuttings are obtained. Potatoes yield 75 to 150 bushels per acre. The Wabash clay, when properly tilled, is the most drought-resisting soil in the county, and crops seldom suffer from lack of moisture.

Crop rotation is probably practiced less on the Wabash clay than on any other soil in the county, as very many of the farms are operated by tenants. The soil is naturally productive, being especially high in organic matter, and does not become so noticeably exhausted as the other soils with continuous use in growing one crop. The soil is hard to handle and can be cultivated only under favorable moisture conditions. Stirred at the proper time it granulates and is similar to a loam as far as subsequent tillage is concerned. If plowed wet, it forms hard refractory clods, which require subsequent freezing and thawing for their disintegration. It is almost impossible to plow the soil when extremely dry. Care should be taken to keep the surface well pulverized, as it cracks badly when not properly cultivated, and the roots of growing crops may be injured. The Wabash clay is locally known as gumbo. More horses and larger tractors are required to draw cultivating implements than on most of the other types.

No commercial fertilizer is used, but barnyard manure is usually applied to the corn land in the spring and fall. Much of the soil receives a shallow veneering of wash from the upland every year, and this tends to maintain its supply of organic matter.

The tenanted farms on this type are rented mostly for cash, rents ranging from \$8 to \$15 an acre, but a few farms lease on the share system. Where this is done the tenant furnishes all equipment and seeds, and gives the owner three-fifths of the crop. In a few cases an additional rent of \$3 an acre is exacted.

Land of this type ranges in price from \$200 to \$350 an acre, the average probably being nearer the higher than the lower figure. The lower priced land occurs in the poorly drained areas and along the Missouri River, where there is danger of destructive erosion.

Wabash clay, poorly drained phase.—In the vicinity of Jackson and Crystal Lakes, in the northeastern part of the county, small areas of Wabash clay are subject to standing water the greater part of each year. These bodies differ little from the typical soil except that they contain a larger proportion of undecomposed organic mat-

ter, which gives them a mucky character. The vegetation on these bodies consists of a thickly matted growth of rushes, reeds, and other water-loving plants.

CASS SILT LOAM.

The surface soil of the Cass silt loam consists of a dark-brown to black mellow silt loam 6 to 12 inches deep, containing a large amount of organic matter, and in places a rather high percentage of very fine sand. The subsoil presents some variations. The typical material is a grayish-brown to gray very fine sandy loam, having a relatively high silt content. In a few places the upper subsoil consists of a light-brown silt loam which grades rather abruptly into the typical grayish-brown very fine sandy loam. Locally the material below 30 inches is a gray, porous fine sandy loam to fine sand, mottled yellowish and rusty brown. In places the subsoil below 24 inches consists of alternating strata of silt and very fine sand, from 1 to 4 inches thick, and occasionally there occurs a layer of silty clay. The change from soil to subsoil is usually abrupt, both in color and texture. The lower subsoil is calcareous. Near the margins of the areas the soil grades into very fine sandy loam on the one hand and silty clay loam on the other. The difference between the Wabash silt loam and Cass silt loam is entirely one of subsoil structure, the former being underlain by a heavy, more or less plastic material.

The type is not extensive in Dakota County. One of the largest bodies occurs along the Chicago, St. Paul, Minneapolis & Omaha Railroad northeast of Hubbard. A very typical area lies on the south side of Omaha Creek northeast of Homer, and other areas occur scattering over the entire Missouri River bottoms.

The surface is flat and only slightly modified by a few narrow, meandering depressions. None of the type is subject to overflow by the Missouri River. Owing to the loose porous subsoil the drainage is generally good.

Like other bottom-land soils the type is largely devoted to the production of staple crops. Practically all of it is under cultivation, chiefly to corn, wheat, oats, and alfalfa. Potatoes and other vegetables are grown for home consumption, but no special crops are raised commercially. Corn is the principal crop. It yields ordinarily between 40 and 50 bushels per acre. Wheat, principally spring wheat, yields from 18 to 25 bushels per acre. As on all the heavy bottom-land types, oats ordinarily grow too rank to be very profitable, though short-strawed varieties give fairly good returns, yielding from 30 to 40 bushels per acre. Alfalfa yields 3 to 5 tons per acre from three cuttings. Wheat is the chief cash crop. It is all sold to the local elevators. Most of the corn is fed to hogs on the farms where produced. Much of the alfalfa and oats is fed to the

work stock and dairy animals, although some is sold to local farmers for feeding purposes.

The soil is easy to handle on account of its mellow structure and thorough drainage. It has a slight tendency to clod when plowed wet, but the lumps are easily reduced. Much of the type is in tenant farms and little attention is given to systematic crop rotation, corn, wheat, and oats being generally alternated but with little regularity; alfalfa stands are retained from 6 to 7 years. Only small quantities of barnyard manure and no commercial fertilizers are used. The physical qualities and flat, even surface of this type, together with its high natural productiveness, make it an excellent general farming soil.

The land is valued at \$275 to \$350 an acre, depending upon improvements and distances from towns.

CASS SILTY CLAY LOAM.

The Cass silty clay loam consists of a surface soil of a dark-brown to black, silty clay loam 8 to 14 inches deep underlain by a gray to brownish-gray, very fine sandy loam subsoil, in many places mottled with rusty brown. The upper subsoil may be a loose, floury, gray silt loam, passing into the characteristic very fine sandy loam material. In a few places the subsoil below 30 inches becomes coarser approaching a fine sandy loam in texture, while in other places the material below 20 inches consists of alternating layers of very fine sand and silt. The surface soil contains a large percentage of organic matter, has a granular structure, and is somewhat sticky and plastic when wet, though readily breaking down upon drying. The subsoil is somewhat calcareous. The type has been deposited in the same manner as the Cass clay.

Areas of the Cass silty clay loam varying from 25 to 500 acres in size lie in the Missouri River bottoms. The total extent of the type is small, and it is of comparatively little importance. The largest body lies in the vicinity of Blyburg Lake in the southeastern part of the county. Parts of Dakota City and South Sioux City are on this type. A small though typical area lies around Heilman School in the east-central part of the county.

The topography is flat, but drainage is generally adequate for crop production on account of the loose, porous nature of the subsoil.

The Cass silty clay loam is very productive, and with the exception of small areas used for groves or building sites it is all in cultivation. About 80 per cent of the soil is tilled. It is devoted to the same agricultural uses as the Cass clay. Corn and alfalfa are the principal crops, with wheat, oats, and potatoes occupying considerable acreages. Part of the type is used for the production of truck crops for the

Sioux City market, though the soil is not so well adapted to this purpose as the sandier members of the Cass and the Sarpy series. Hogs are raised on most of the farms, but very few cattle, as most of the land is used for crop production. Corn gives an average yield of 35 bushels, wheat 25 bushels, oats 30 bushels, potatoes 100 bushels, and alfalfa $3\frac{1}{2}$ tons per acre per season.

The soil of the Cass silty clay loam is rather difficult to handle on account of its high clay content, but it can be worked under a somewhat wider range of moisture conditions than the Cass clay. If plowed when wet clods are formed and these are not easily broken down in subsequent cultivation.

No definite rotation is practiced, but crops are changed irregularly every two or three years. Alfalfa is planted quite extensively. This crop tends to interfere with short rotation systems. No commercial fertilizer is used, but the available barnyard manure is applied in the spring and fall.

Land of the Cass silty clay loam sells for \$250 to \$350 an acre, depending upon improvements and location with respect to towns. Those areas lying within the city limits of Dakota City and South Sioux City are not taken into consideration in the above-mentioned values.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Cass silty clay loam:

Mechanical analyses of Cass silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
373123.....	Soil.....	0.0	1.5	2.3	13.1	10.1	40.0	33.2
373124.....	Subsoil.....	.0	.0	.5	2.7	59.2	32.1	5.6

CASS CLAY.

The Cass clay consists of dark-gray, dark-brown, or almost black, heavy plastic clay 8 to 10 inches deep, slightly mottled in places with yellowish and reddish stains, underlain by a slate-colored or light-gray subsoil mottled slightly with reddish yellow. The subsoil has the same texture as the surface material to an average depth of 20 inches, where a mottled, light-gray, brown, yellow, and reddish-yellow sandy silt to very fine sandy loam is usually encountered. At about 30 inches the subsoil generally becomes coarser in texture, being a loose, somewhat incoherent, very fine sandy loam of a grayish-brown color, though in places the heavy clay, differing from the surface material only in color, extends below the 3-foot level.

In other localities the subsoil changes at about 30 inches into a heavy, compact, bluish clay, much resembling the lower subsoil of the Wabash clay. The surface soil is heavy and plastic when wet, and hard and brittle when dry.

The Cass clay contains a large quantity of organic matter in the surface soil, and undecayed plant remains are sometimes encountered in the subsoil. The lower subsoil is generally calcareous. The type owes its origin to the silting-up of abandoned channels of the Missouri River. Where the deposition of clay has exceeded 3 feet the soil is mapped with the Wabash clay.

The largest development of Cass clay occurs along the bluff line between the Missouri River and Elk Creek. Several smaller areas are located southwest of Dakota City, and a body is mapped along Omaha Creek in the southeastern part of the county.

The surface of the type is flat, except in places where it is modified by shallow elongated depressions. Drainage is generally good, as none of the soil is subject to overflow by the Missouri River, and the loose, porous subsoil gives free internal movement of moisture.

The Cass clay is an important agricultural type, as it is a strong soil and well adapted to all crops common to the region. There is, however, only about 4 square miles of this type in Dakota County. About 85 per cent of it is in cultivation; the remainder supports a dense growth of cottonwood and willow. Very few cattle are raised on this type, as most of it is used for crop production, but many farmers annually raise and fatten a number of hogs. The Cass clay is well adapted to the production of corn, wheat, oats, and alfalfa. Wheat, oats, and alfalfa do better on this soil than on the Wabash clay, the condition of underdrainage being more favorable. Corn yields 30 to 50 bushels, wheat 25 to 30 bushels, oats 30 to 35 bushels, and alfalfa 3 to 5 tons per acre from three cuttings.

On account of its more open subsoil, the Cass clay is not so drought resistant as the Wabash clay, but when properly managed crops seldom suffer from lack of moisture. The heavy clay soil is difficult to handle, and it should not be cultivated when wet, as the soil puddles and refractory clods are formed. The surface cracks badly in dry weather, but with proper cultivation the cracks are kept filled and little moisture is lost through evaporation.

Systematic crop rotation is not practiced on this type, though the same crop is seldom planted on the same land more than three years in succession. Alfalfa is being more generally grown, with very beneficial results to the soil. Barnyard manure, when available, is applied to the land.

Many of the farms on this type are operated by tenants. Rents have about the same range as on the Wabash clay.

The Cass clay sells for \$200 to \$300 an acre, depending upon improvements and location.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Cass clay:

Mechanical analyses of Cass clay.

Number.	Description.	Fine	Coarse	Medium	Fine	Very fine	Silt.	Clay.
		gravel.	sand.	sand.	sand.	sand.	Per cent.	Per cent.
373111.....	Soil.....	0.0	1.5	1.4	7.0	8.0	41.5	40.7
373112.....	Subsoil.....	.0	.8	.8	6.1	10.6	56.4	25.3

SARPY FINE SANDY LOAM.

The Sarpy fine sandy loam consists of a light grayish brown fine sandy loam to loamy fine sand 8 to 15 inches deep, underlain by a subsoil of light-gray to yellowish-gray, loose, incoherent fine sand. The material becomes coarser with depth, and medium sand and fine gravel are commonly encountered in the lower part of the 3-foot profile. The subsoil usually shows some iron stains, varying in color from rusty brown or brown to reddish yellow. The soil is not uniform in texture, and bodies of fine sand too small to be indicated on the map are of common occurrence within its boundaries. The surface soil has been removed by the wind from many of these small patches exposing an almost white incoherent fine to medium sand subsoil. Both soil and subsoil of the Sarpy fine sandy loam are deficient in organic matter.

The total area of the type is not large, although there are a few bodies of considerable size. The soil occurs chiefly adjacent to areas of Riverwash. The largest development is in the northern part of the county. Another large body lies north of Blyburg Lake in the southeastern part of the survey, and a smaller, though very typical, area is located near Crystal Lake northwest of Sanders Beach.

The surface of the type is in general flat, though in many places modified by low, narrow ridges and small knolls, composed chiefly of fine sand. Drainage is good. A very small proportion is subject to overflow from the Missouri River, though water stands on the land but a short time, the loose, coarse soil and subsoil allowing it to drain away freely.

The type is not an important soil in this county. Only about 40 per cent of it is under cultivation, the remainder being in native timber and grasses and used largely for pasture. Small cottonwood and willow trees cover the virgin areas. As a rule the forest growth is not thick, though the willows are so dense in some places as to

make them almost impenetrable. Corn is the principal crop, and about 70 per cent of the cultivated land is devoted to its production; but owing chiefly to the deficiency of organic matter and to unfavorable moisture conditions yields are low, averaging about 20 bushels per acre. The type is droughty, and crops often suffer from lack of moisture during dry weather. The soil is not adapted to small-grain crops, on account of its loose, open structure. Truck crops, such as watermelons, cantaloupes, pumpkins, squashes, cucumbers, and tomatoes, do well in favorable seasons, if the land is heavily manured.

The soil is easily handled and does not require heavy teams or strong machinery for its cultivation, and it can be plowed under any moisture conditions without injury. No commercial fertilizer is used, but barnyard manure is applied to the cultivated areas twice each year, the supply, however, being generally inadequate.

The improved areas of the Sarpy fine sandy loam sell for about \$125 an acre. The forest land can be purchased much cheaper, as it is at the present time suitable only for pasture.

The type is greatly deficient in organic matter, and every possible means should be used to incorporate this material. The plowing under of green crops, planting of legumes, and heavy applications of barnyard manure will greatly increase the producing power of the soil. Land of this type should be kept in alfalfa or other cover crops in order to prevent the soil from blowing.

SARPY VERY FINE SANDY LOAM.

The surface soil of the Sarpy very fine sandy loam consists of a loose, friable, yellowish-gray to light-brown, very fine sandy loam 8 to 16 inches deep, in places containing a relatively large proportion of silt, here approaching a coarse silt loam in texture. The subsoil is a light-gray, gray, or grayish-brown, somewhat lighter-textured, very fine sandy loam, often slightly streaked with iron oxides and in places mottled with light gray and yellow. There is no marked difference between the soil and subsoil; the former is slightly heavier in texture. Layers of fine sand, silt, and silty clay are common throughout the 3-foot section. More often, however, the subsoil increases in coarseness with depth. The type is variable in texture and includes narrow ridges and knolls of fine sandy loam too small to be indicated separately on the map. Both soil and subsoil are deficient in organic matter. The subsoil is more or less calcareous.

This type is one of the more extensive soils in the Missouri River bottom land. The largest developments are in the northeastern part of the county in the vicinity of Crystal and Jackson Lakes, but areas are mapped in the bottoms throughout their extent in the county. A

very typical body is located on the north side of Blyburg Lake and another around Sanders Beach near Crystal Lake.

The surface of the Sarpy very fine sandy loam is in general flat, though in places it is marked by numerous small ridges composed of coarser sands. The type, as a whole, is well drained, though there are a few areas adjacent to the Missouri River that are subject to overflow during periods of exceptionally high water.

The type is very important in Dakota County, and about 80 per cent of it is under cultivation, the remainder being used for pasture and wood lots. Much of its area originally was covered with a dense growth of scrub timber consisting of willow, cottonwood, some elm, and ash, but most of this has been removed. A small area north of The Chute, in the northeastern part of the county, still remains in its virgin forest, which is so thick as to be almost impenetrable.

Corn, the chief crop on this type, occupies about 50 per cent of the total area. Alfalfa ranks second in acreage, with truck crops and potatoes third. Corn and alfalfa are generally consumed on the farms where produced. Many farmers on this type specialize in truck gardening and a few in potato growing to supply the Sioux City markets. The land is admirably adapted to trucking, as the soil is loose and friable and can be worked earlier in the spring than any other in the county. Watermelons, muskmelons, squashes, pumpkins, tomatoes, and cucumbers are grown quite extensively, and a few farmers grow also onions, peppers, lettuce, beets, and cabbage. Small acreages of wheat and oats are grown, but the type is not well suited to the production of small grains, especially wheat, being too light in texture.

Corn gives an average yield of 25 bushels, potatoes 150 bushels, and alfalfa from 3 to 4 tons of hay per acre per season. No data can be given on the yields of truck crops, as the industry is new and records have not been kept.

Systematic crop rotation is given little or no attention on this soil, although field crops are generally changed every second or third year and similar truck crops usually are not planted on the same ground more than two years in succession.

The Sarpy very fine sandy loam does not require heavy draft animals or strong farm equipment; it can be handled under any moisture conditions, and though clods form if the land is plowed when extremely wet, they are easily reduced by harrowing. No commercial fertilizer is used. Barnyard manure is applied where obtainable, especially to land intended for truck crops. The supply is generally insufficient, and the yields are beginning to decline. The soil is naturally deficient in organic matter, and every means should be employed to increase the supply.

Land of the Sarpy very fine sandy loam sells for \$200 to \$300 an acre, depending on location with respect to markets.

Sarpy very fine sandy loam, poorly drained phase.—Areas of a poorly drained phase of the Sarpy very fine sandy loam in the northeastern part of the county have been indicated on the soil map. This phase occurs in a low area forming a part of an old cut-off channel of the Missouri River. A chain of small lakes occupies the lowest part of this old channel, Jackson Lake being farthest east, and the poorly drained body covers the intervening slightly higher land. Another small area extends along the southern side of Crystal Lake. The total area of the phase is about 1 square mile.

This phase is low and flat for the most part, with occasional low hummocks and ridges. For a part of the year the surface is covered by water; during the remainder the water table is very near the surface.

No differences can be observed between this phase and the typical Sarpy very fine sandy loam except those brought about by frequent inundation.

A large part of the area might be reclaimed by a system of deep ditches.

RIVERWASH.

Riverwash, as mapped in the present survey, comprises mainly areas of muddy or silty flats and sand bars along the Missouri River. In most areas the material is a light-gray to almost white, very fine sand to fine sand. There is little coarse material, such as is usually included in Riverwash areas.

The greater part of the Riverwash lies only a few feet above the flow of the stream and is flooded with each slight rise in the river. The areas vary in width from extremely narrow strips where the river skirts the bluffs to bodies considerably more than 1 mile wide, as northeast of Homer.

An area north of the mouth of Omaha Creek lies slightly higher than the rest of the type. The soil here consists of a brownish-gray very fine sandy loam to a depth of 18 inches, underlain by yellowish-gray very fine sand, conspicuously streaked with yellowish-brown stains. The area is in a transitional stage and with further development and weathering will probably become Sarpy very fine sandy loam. It is covered with a rather dense and tall growth of willow and cottonwood, with scattering elm trees.

Riverwash is generally not a permanent soil, and the material changes with each overflow. Even during normal flow small areas are shifted about, destroyed, or added to by the varying currents. The material drifts easily and on windy days forms white sand clouds that can be seen for several miles. For the most part, except for a few willow seedlings, it is practically devoid of vegetation.

A very small proportion of the type is used in the fall of the year as grazing land for cattle and horses. Most of it, however, is of no agricultural value at present.

ROCK OUTCROP.

In a few places in Dakota County members of the underlying formations have been exposed in areas of sufficient size to warrant mapping, and such areas are indicated on the soil map as Rock outcrop. They consist of limestone of Pennsylvanian age and of the Dakota sandstone of Cretaceous age. The formations have had very little influence upon the soils of the county. Areas in which they outcrop can not be cultivated. The largest exposures lie along Fiddlers Creek southwest of Homer. A small area is developed along the bluff line northwest of Homer.

SUMMARY.

Dakota County is located in the northeastern part of Nebraska, bordering the Missouri River. It contains 258 square miles or 165,120 acres. About three-fifths of its total area is upland and the remainder bottom land, including the terraces. The topography of the upland ranges from gently undulating or rolling to hilly and extremely dissected, while the bottom land and terraces have a generally flat surface.

The county is drained by the Missouri River and its tributaries—Elk and Omaha Creeks. The general direction of the upland drainage is north and east and that of the bottom land south and east. As a whole the county is well drained.

The first settlement was made in 1855, and the county was organized the same year. The early settlers came largely from the Central and Eastern States.

According to the census of 1920 the population of the county is 7,694. It is all classed as rural. Dakota City, with a population of 399 in 1920, is the county seat, and South Sioux City, with a population of 2,402, is the largest town in the county.

The transportation facilities of the county are good. Railroads cross it in several directions and a comprehensive road system reaches all the farming communities. South Sioux City is the principal grain and vegetable market. Live stock is shipped to Omaha.

The climate of Dakota County is favorable for the production of the common staple crops, such as corn, wheat, oats, potatoes, and alfalfa. The mean annual temperature is 47.1° F., and the mean annual precipitation is 25.96 inches. The rainfall is generally quite favorably distributed. The average length of the growing season is 157 days.

The type of agriculture usually practiced consists of grain farming and stock raising, including dairying. Truck crops are grown

to a small extent. Nearly all the farms are well improved and the equipment is modern and sufficient. The work stock consists of medium to heavy draft horses and mules. Tractors are being used more extensively.

Only a rather indefinite system of crop rotation, subject to numerous substitutions, is practiced. No commercial fertilizer is used, but all the manure produced is applied to the land.

Eleven soil types representing six series, and two nonagricultural types, Riverwash and Rock outcrop, occur in the county. They form three groups—upland soils, colluvial and alluvial slope soils, and alluvial or first-bottom soils.

The Marshall silt loam of the upland is the most extensive and important soil in the county. It is adapted to all the crops grown, but especially to corn.

The Knox silt loam is naturally a productive soil, though not so strong as the Marshall silt loam. It differs from that type chiefly in the lighter color of its surface soil and the lower organic matter content.

The Judson silt loam is the only colluvial type mapped in the county. It has a flat surface and in many places closely resembles bench or terrace land. The type is largely used in the production of corn.

The Wabash silt loam is the strongest corn soil in Dakota County and stands continued cropping better than any other type.

The Wabash silty clay loam is well adapted to corn, wheat, and alfalfa. It is somewhat difficult to handle and tends to clod when plowed wet.

The Wabash clay is the most extensive and important soil of the bottom lands. It is the heaviest and the most difficult to handle of any of the types in the county, but under proper management is one of the most productive soils.

The Cass silt loam is devoted to the production of corn, wheat, oats, and alfalfa. The Cass silty clay loam differs little from the Cass clay except in the texture of its surface soil.

The Cass clay is a very productive soil. It differs from the Wabash clay in the lighter texture of its subsoil.

The Sarpy fine sandy loam is of little agricultural importance. It is very deficient in organic matter.

The Sarpy very fine sandy loam occurs chiefly in the northeastern part of the county. It is used to a considerable extent for trucking.

Riverwash includes sand bars and silty flats along the Missouri River. It is of no agricultural value.

Accessibility Statement

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SOIL MAP
NEBRASKA
DAKOTA COUNTY SHEET

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NEBRASKA SOIL SURVEY

LEGEND

